PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:) Group Art Unit:

SMITH.) Examiner:

Serial No.: Not Yet Assigned) **FIRST PRELIMINARY AMENDMENT**

Filed: Herewith

Atty. File No.: 1604-316-CIP

For: "ON-AXIS LASER RECEIVER WAVELENGTH DEMULTIPLEXER WITH INTEGRAL IMMERSION LENSED DETECTORS"

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TYPED OR PRINTED NAME Angela P. Davis

SIGNATURE: ______

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the initial review of the above-identified patent application by the Examiner, please enter the following First Preliminary Amendment. Please enter the first Preliminary Amendment before computing the filing fees.

Please amend the above-identified patent application as follows:

IN THE TITLE:

Please change the title to "PROCESSING OF MULTIPLE WAVELENGTH SIGNALS TRANSMITTED THROUGH FREE SPACE"

IN THE SPECIFICATION:

Please replace the paragraph found at page 1, lines 4-10, with the following:

The present application claims under 35 U.S.C.§119(e) the benefits of U.S. Provisional Application Serial No. 60/264,079, filed January 24, 2001, entitled "On Axis Laser Receiver Wavelength Demultiplexer with Integral Immersion Lensed Detectors" and is under 35 U.S.C.§120 a continuation-in-part of U.S. Patent Application Serial No. 09/339,316, filed June 23, 1999, to Smith entitled "RECEIVING MULTIPLE WAVELENGTHS AT HIGH TRANSMISSION RATES", both of which are incorporated herein by this reference.

Please amend the text at page 10, lines11-14, as follows:

Fig. 14 is a plan view of a substrate including a plurality of detector units and a corresponding plurality of lenses or essentially hemispherical surfaces;

Fig. 15 is a cross-sectional view of a detector unit and immersion lens according to another embodiment of the present invention; and

Fig. 16 is a schematic view of an optical receiver according to yet another embodiment of the present invention.

Please insert the following language at page 25, line 14:

Yet another embodiment of a laser communication receiver is shown in Fig. 16. Referring to Fig. 16, a linking device 1200 is placed near the tip of the cone-shaped focus or focal area to redirect the laser beams 112 to their respective focusing element 124. Each laser beam 112 has a focal area which is near its respective linking device 1200. In this embodiment, the linking device

1200 is a pick-off mirror. The pick-off mirror is angled to redirect the laser beam 112 to the focusing element 124.

The detector unit 128 converts the modulated laser beam 112 into an electrical signal which contains the modulation data. At data rates above 1 gigabit/sec., wide band detectors are required, such as a PIN diode or the like. However, wide band detectors with a large diameter are currently unavailable. As detectors get larger their capacitance increases. If large enough, this capacitance obscures the modulated data. Accordingly, for data rates above 1 gigabit/sec., currently available PIN diodes are limited to a diameter of approximately 40 microns.

The focusing element 124 receives the laser beam 112 from the linking device 1200 and focuses the light to reduce the spot size diameter. This focusing preferably reduces to less than 50 microns the greater than 100 micron spot size. Preferably, the spot size is reduced to 40 microns or less. Reducing the spot size allows focusing more light on the detector unit 128 which improves data transmission efficiency. For example, if a 40 micron detector were used with a spot size of 200 microns, only 4% of power would reach the detector.

To enable focusing, the speed of the laser light may be reduced in the focusing element 124 to 30% or less of the speed through free space. The focusing element 124 preferably has an index of refraction of 2 or more. Preferably, the focusing element 124 could be made of Silicon or Germanium which respectively have indices of refraction of 3.5 and 4. Silicon is preferred for wavelengths around 1500 nm and Germanium is preferred for wavelengths around 2000 nm.

With reference to Fig. 16, a channel pick-off assembly or sorter block 2000 is shown with four focal cones 2040 incident thereon. Each focal cone 2040 corresponds to a slightly different wavelength λ and has a focal area 2080 offset from the focal areas 2080 for the other wavelengths λ. The sorter block 2000 includes a glass rod 2120, four linking devices 1200, four focusing elements 124, and four detector units 128. Each focal cone 2040 corresponds to a different modulated laser beam 112 which carries different data. Although not shown in Fig. 16, the holographic unit 116 is positioned so as to produce the four focal cones 2040 which are spaced apart because each results from laser light of slightly different wavelengths λ. Each focal cone 2040 has at its apex a focal area 2080. In this embodiment, the focal cone is 20° to provide good separation between the four modulated laser beams 112.

The linking device, such as pick-off mirror 1200, is positioned at the focal area 2080 to redirect the laser light to a focusing element 124. The pick-off mirrors 1200 are small to reduce the interference with other focal cones 2040. The focusing element 124 focuses the laser light to reduce the spot size for a detector unit 128. Preferably, the detector unit 128 is in direct contact with the focusing element 124, although, it need not be.

<u>IN THE DRAWINGS:</u>

Please add new Figure 16 attached hereto.

<u>IN THE CLAIMS:</u>

Please cancel Claims 1-86, before determining the filing fees, and add the following new Claims 87-123.

87. (New) A method for receiving high frequency signals, comprising:

transmitting at least one signal including first and second data from a transmitter through atmospheric turbulence to a receiver, wherein the receiver is located at a distance from the transmitter, wherein the at least one signal, after transmission through the atmospheric turbulence, has a distorted wavefront, wherein said transmitting of said first and second data is conducted at a rate greater than one gigabit/second, and wherein each of said first and second data is associated with first and second wavelength channels, respectively, the first wavelength channel being different from the second wavelength channel;

receiving said at least one distorted signal including said first and second data at a detector assembly;

detecting said first data using a first detector unit of the detector assembly, wherein the first detector unit is located at a first position; and

detecting said second data using a second detector unit of the detector assembly, wherein the second detector unit is located at a second position that is different from said first position.

88. (New) A method, as claimed in Claim 87, wherein:

said detecting first data step includes detecting at the same time, using said first detector unit, all of said first data that was received by said first position of said detector assembly at a particular instance in time.

89. (New) A method, as claimed in Claim 87, wherein:

said detecting first data step includes accepting a focal spot size diameter of greater than 40 microns and then reducing said focal spot size diameter.

90. (New) A method, as claimed in Claim 89, wherein:

said reducing step includes using a focusing element having a refractive index greater than 2.

91. (New) A method, as claimed in Claim 90, wherein:

said focusing element has a traverse length along and through which said first data having said associated first wavelength channel passes, and the speed of said first data in passing along and through said traverse length is no greater than 30% of the speed of light in air.

92. (New) A method, as claimed in Claim 89, wherein:

said focal spot size diameter is greater than about 100 microns.

93. (New) A method, as claimed in Claim 87, wherein:

said detector assembly includes a linking device, a focusing element and a detector unit.

94. (New) A method, as claimed in Claim 87, further comprising after the transmitting step:

finitely focusing, with a holographic unit, said first data to form a first beam and second data to form a second beam.

95. (New) A method, as claimed in Claim 87, wherein:

said detecting first data step includes reflecting said first data associated with said first wavelength channel by a first mirror to a focusing element and with an output of said focusing element being in communication with said first detector unit.

96. (New) A method, as claimed in Claim 87, wherein in said receiving step said first data is finitely focused on a first focal point and said second data is finitely focused on a second focal point and the first points is at least substantially at the first location and the second focal point is at least substantially at the second location.

97. (New) A method, as claimed in Claim 87, wherein:

said detecting said second data step includes accepting said second data using a linking device, directing said second data to a second focusing element and with the output of said second focusing element being in communication with said second detector unit.

98. (New) An apparatus for receiving high frequency data associated with a first wavelength, comprising:

a holographic unit that receives said data; and

a detector assembly responsive to said holographic unit for detecting said data, said detector assembly including a focusing element having a refractive index that reduces a focal spot size associated with said data, wherein the focusing element is in direct physical contact with the detector unit.

99. (New) An apparatus, as claimed in Claim 98, wherein:

said refractive index is greater than 2 and said focusing element reduces said focal spot size from a focal spot size diameter of greater than 100 microns to a focal spot size diameter of less than 50 microns.

100. (New) An apparatus, as claimed in Claim 98, wherein:

said detector assembly includes a linking device and a detector unit and with said focusing element being disposed between said linking device and said detector unit, with said focusing element receiving an input from said linking device and providing an output to said detector unit.

101. (New) An apparatus, as claimed in Claim 98, wherein:

said detector assembly includes a detector unit positioned at a distance from a focal area provided by said holographic unit and being associated with said data having said first wavelength.

102. (New) An apparatus, as claimed in Claim 98, wherein:

said data comprises first and second data and said detector assembly includes a sorter block for accepting said data and for providing a first communication path for said first data and a spatially offset second communication path for said second data.

103. (New) An apparatus, as claimed in Claim 98, wherein:

said detector assembly includes a linking device that accepts said first data associated with a focal spot size greater than 50 microns.

104. (New) An apparatus, as claimed in Claim 98, wherein:

said linking device includes a pick-off mirror, with said pick-off mirror being able to properly reflect a focal spot size greater than 200 microns.

105. (New) An apparatus, as claimed in Claim 98, wherein:

said holographic unit includes at least one of the following: a volume hologram, and a holographic mirror.

106. (New) A system for receiving high frequency signals, comprising:

a receiver that receives at least one signal including first and second data and comprises a detector assembly; and

a transmitter that transmits the at least one signal through atmospheric turbulence to the receiver, wherein the receiver is located at a distance from the transmitter, wherein the at least one signal, after transmission through the atmospheric turbulence, has a distorted wavefront, wherein said first and second data are each transmitted at a rate greater than one gigabit/second, wherein said first and second data are respectively associated with first and

second wavelength channels, the first wavelength channel being different from the second wavelength channel, and wherein the detector assembly comprises at least a first detector unit located at a first position for detecting said first data, and a second detector unit located at a second position for detecting the second data, the second position being different from said first position.

107. (New) A system, as claimed in Claim 106, wherein:

said detector assembly includes a first focusing element that finitely focuses the first data onto the first detector unit, wherein a focal spot size of the first data has a diameter of greater than 40 microns.

108. (New) A system, as claimed in Claim 107, wherein:

said focusing element has a refractive index greater than 2.

109. (New) A system, as claimed in Claim 108, wherein:

said focusing element has a traverse length along and through which said first data having said associated first wavelength channel passes, and the speed of said first data in passing along and through said traverse length is no greater than 30% of the speed of light in air.

110. (New) A system, as claimed in Claim 108, wherein:

said focal spot size diameter is greater than about 100 microns.

111. (New) A system, as claimed in Claim 106, wherein:

said detector assembly includes a linking device, a focusing element and a detector unit.

112. (New) A system, as claimed in Claim 106, further comprising:

a holographic unit that finitely focuses said first and second data in said at least one distorted signal at the first and second locations.

113. (New) A system, as claimed in Claim 107, wherein the detector assembly comprises:

a first mirror that reflects said first data associated with said first wavelength channel onto the focusing element.

114. (New) A method for receiving high frequency data associated with at least a first wavelength channel, comprising:

receiving said first wavelength channel after the first wavelength channel has passed through atmospheric turbulence and thereby become optically distorted;

finitely focusing said received first wavelength channel with a first optical element to form a focused first beam having a focused first spot size;

further finitely focusing the focused first beam with a second optical element to form a further focused first beam having a further focused first spot size that is smaller than the focused first spot size, wherein the first and second optical elements are at different spatial locations;

detecting at least a portion of the data in the further focused first beam.

115. (New) A method, as claimed in Claim 114, wherein the first optical element is a holographic unit.

116. (New) A method, as claimed in Claim 114, wherein the second optical element is a focusing element having a refractive index greater than 2.

117. (New) A method, as claimed in Claim 114, wherein the data includes a second wavelength channel different from the first wavelength channel and further comprising:

receiving said second wavelength channel after the second wavelength channel has passed through atmospheric turbulence and thereby become optically distorted;

finitely focusing said received second wavelength channel with the first optical element to form a focused second beam having a focused second spot size, the focal point of the focused first beam being different from the focal point of the focused second beam;

further finitely focusing the focused second beam with a third optical element to form a further focused second beam having a further focused second spot size that is smaller than the focused second spot size, wherein the first and third optical elements are at different spatial locations;

detecting the data in the further focused second beam.

118. (New) A method, as claimed in Claim 114, wherein:

said second focusing element reduces said focal spot size from a focal spot size diameter of greater than 100 microns to a focal spot size diameter of less than 50 microns.

119. (New) A method, as claimed in Claim 115, wherein:

said holographic unit includes at least one of the following: a volume hologram and a holographic mirror.

120. (New) A method, as claimed in Claim 87, wherein said transmitting step includes:

modulating said first and second data on a respective light beam to form first and second modulated light beams, respectively, and further comprising:

demodulating the detected first and second data.

121. (New) A method, as claimed in Claim 93, wherein a first linking device corresponds to the first detector and a second linking device corresponds to the second detector, wherein the first and second linking devices are in different spatial locations, wherein the first data detecting step comprises:

redirecting, with the first linking device, said first data from a first optical path to a transversely oriented second optical path, the second optical path intersecting the first detector unit; and

wherein said second data detecting step comprises:

redirecting, with the second linking device, said second data from a third optical path to a transversely oriented fourth optical path, the fourth optical path intersecting the second detector unit.

122. (New) A method, as claimed in Claim 87, wherein a spacing between said first and second wavelength channels is about 4 nanometers.

123. (New) An apparatus, as claimed in Claim 98, wherein the linking device is located at a distance from the detector unit and is configured to redirect said data from a first optical path to a transversely oriented second optical path.

REMARKS/ARGUMENTS

The above amendments are supported in the Specification. For example, regarding the text inserted into the Specification and new Fig. 16, the text and figure are extracted from page 7, line 22, to page10, line 8, and Fig. 2, respectively, of U.S. Application, Serial No. 09/339,316, filed June 23, 1999, and entitled "RECEIVING MULTIPLE WAVELENGTHS AT HIGH TRANSMISSION RATES", from which the present application claims priority under 35 U.S.C.§120. At page 1, lines 7-10, of the Specification, this application is incorporated by reference into the present application.

Attached hereto is a marked up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version With Markings to Show Changes Made."**

Respectfully submitted,

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Date: Jan. 21, 2002

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Please amend the text at page 10, lines11-14, as follows:

Fig. 14 is a plan view of a substrate including a plurality of detector units and a corresponding plurality of lenses or essentially hemispherical surfaces; ~~and~~

Fig. 15 is a cross-sectional view of a detector unit and immersion lens according to another embodiment of the present invention; and

Fig. 16 is a schematic view of an optical receiver according to yet another embodiment of the present invention.

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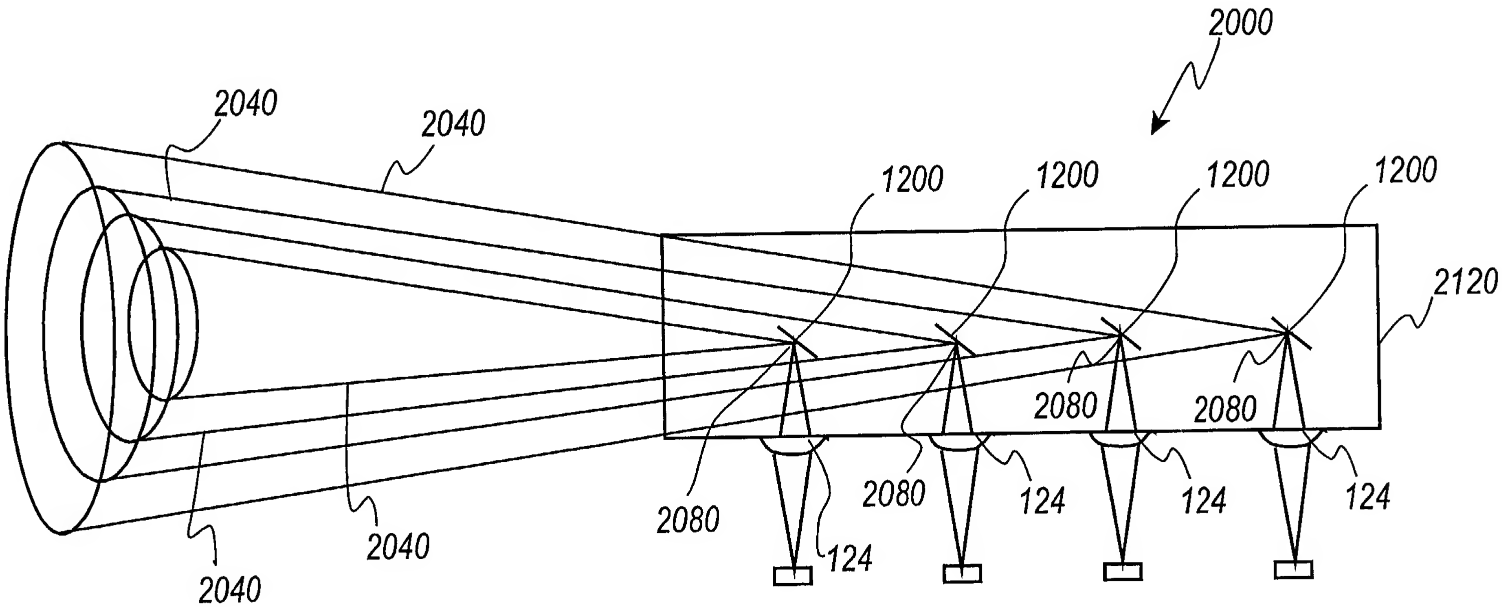
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FIG. 16